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5.8.1 Railings

Since *National Cooperative Highway Research Program (NCHRP) Report 350* was published in 1993, traffic railings have been rated according to the crash test standards contained in the report. The AASHTO LRFD provisions for railings follow the report. The office has designed the deck overhang on standard sheets according to the AASHTO LRFD Specifications.

Because traffic railings are attached to the bridge deck, the designer also should consult the decks article in this manual [BDM 5.2]. The intent of the traffic railing and supporting deck design is to make the deck stronger than the railing so that a crash-related railing failure will not propagate into the superstructure [BDM 5.2.2.4].

Office policies for pedestrian railings, bicycle railings, separation railings, and aesthetic railings currently are under discussion. As needed, contact the Methods Engineer for policies to be applied to specific projects.

5.8.1.1 General

5.8.1.1.1 Policy overview [AASHTO-LRFD 13.7.2]

Most new Iowa highway bridges are designed only for vehicular traffic and make use of the F-shape barrier rails detailed on standard sheets developed by the office. The standard barrier rails meet *National Cooperative Highway Research Program (NCHRP) Report 350* Test Level 4 (TL-4) if 34 inches (865 mm) tall or Test Level 5 (TL-5) if 44 inches (1.120 m) tall. Although in the past TL-4 has been considered adequate for most Iowa highways, the Highway Division Management Team recently adopted a more conservative policy that requires TL-5 rails for all mainline interstate bridges and for primary highway bridges with certain conditions [OBS MM No. 162]. The designer will need to check all primary highway bridges with respect to the new policy.

Office standard sheets detail two types of F-shape end sections and F-shape standard sections for all typical conditions. The first vertical end post section type is for high-speed highways that require

connections for thrie beam guardrail beyond the bridge. The second, rounded end section type is for low-speed highways in urban areas where no guardrail connection is necessary. In cases where the railing has a maximum expansion joint opening 4 inches (102 mm) or greater the designer will need to provide steel cover plates [BDM 5.8.1.2.6, OBS MM No. 207].

The standard F-shape barrier rails are tall enough that they restrict sight distance for motorists in some vehicles, and in some highway situations an open railing may be advisable. During winter snow plowing, the standard TL-4, F-shape rail provides a reasonable amount of splash protection for roadways underneath the bridge, however, the office provides taller rails such as a TL-5 or splashboards for better protection of railways underneath the bridge.

In urban areas a bridge often will include a sidewalk or shared-use trail along one or both edges of the roadway. Standard sheets developed by the office provide for a sidewalk and separation barrier along the edge of a roadway. For a trail the separation barrier is a combination railing constructed with a concrete lower section to which a steel railing is attached on the trail side. At the outer edge of the bridge a chain link fence is provided for protection of pedestrians. For these situations consult the Methods Engineer for the latest policies because the policies in subsequent articles may change before the next manual update.

For bridges given special aesthetic treatment, railings usually will be redesigned to meet the aesthetic theme. Because traffic railings typically will need to meet Test Level 4 (TL-4) or 5 (TL-5), but crash testing is not economically feasible, the designer will need to consider existing crash tested railings. The designer should consult the Federal Highway Administration (FHWA) NCHRP Report 350 Hardware web site that contains a listing of crash-tested railings so as to select a design that meets the test level criterion [BDM 5.8.1.1.5]. The design guidelines in NCHRP Report 554 provide the designer with additional aesthetic alternatives for safety shape concrete barriers [BDM 5.8.1.1.5]. The designer may also choose to contact the Methods Section in the Office of Design, as well as other states for details on crash-tested railings.

The office upgrades existing traffic railings or barrier rails during repair projects. Requirements for rail retrofits are given in the bridge repair article of this manual [BDM 9.1.9.2.2].

For staged construction the office usually is responsible for layout of temporary barrier rail (TBR) on the bridge deck. Information on the use of TBR is given in this railings article and also in the bridge repair article [BDM 5.8.1.3, 9.1.8.3].

5.8.1.1.2 Design information

If a bridge project requires traffic railings crash tested above Test Level 4 or 5 (TL-4 or TL-5) or if attachment of guardrail is unusual, the Methods Section in the Office of Design will provide the designer with appropriate information. The designer should consult with the Office of Design as needed.

5.8.1.1.3 Definitions

F-shape is the safety shape typically used by the office for traffic railings. Although it is similar to a New Jersey shape, the F-shape reduces vehicular climbing.

Primary Highway System: "Primary roads" or "primary road system" means those roads and streets both inside and outside the boundaries of municipalities which are under department (defined as state department of transportation) jurisdiction [Iowa Code 306.3.6].

5.8.1.1.4 Abbreviations and notation [AASHTO-LRFD 13.7.2]

CCS, continuous concrete slab
CWPG, continuous welded plate girder
FHWA, Federal Highway Administration
NCHRP, National Cooperative Highway Research Program

NHS, National Highway System
PPCB, pretensioned prestressed concrete beam
RSB, rolled steel beam
TBR, temporary barrier rail
TL-3, TL-4, TL-5, TL-6, test levels for traffic railings, as defined in *NCHRP Report 350* [AASHTO-LRFD 13.7.2]

5.8.1.1.5 References

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http://safety.fhwa.dot.gov/roadway_dept/policy_guide/road_hardware/barriers/bridgerailings/docs/bridgerail_analysis_may16.pdf~~fourthlevel/hardware/bridgerailings.htm~~)

5.8.1.2 Permanent railings

5.8.1.2.1 Traffic railings [AASHTO-LRFD 13.7.2]

The Highway Division Management Team recently approved a new policy for determining Test Levels (TL) and the associated heights for railings on interstate and primary road bridges [OBS MM No. 162]. The policy is intended to be a supplement to the current AASHTO LRFD Specifications [AASHTO-LRFD 13.7.2].

The new policy states the following:

- The need for a TL-6, minimum height 92 inches (2.340 m) railing is not anticipated for the vast majority of bridges in Iowa.
- All new interstate mainline bridges shall require a TL-5 railing, minimum height 44 inches, 42 inches plus 2 inches (1120 mm, 1070 mm plus 50 mm) for future overlay.
- Bridge railing test level and the associated height for other primary highways shall be evaluated by the Pre-Design Section in the Office of Design for replacement structures and the Preliminary Bridge Section in the Office of Bridges and Structures for other bridges. Basically the evaluation will follow the flow chart in Figure 5.8.1.2.1 and additional information in the policy statement [OBS MM No. 162].

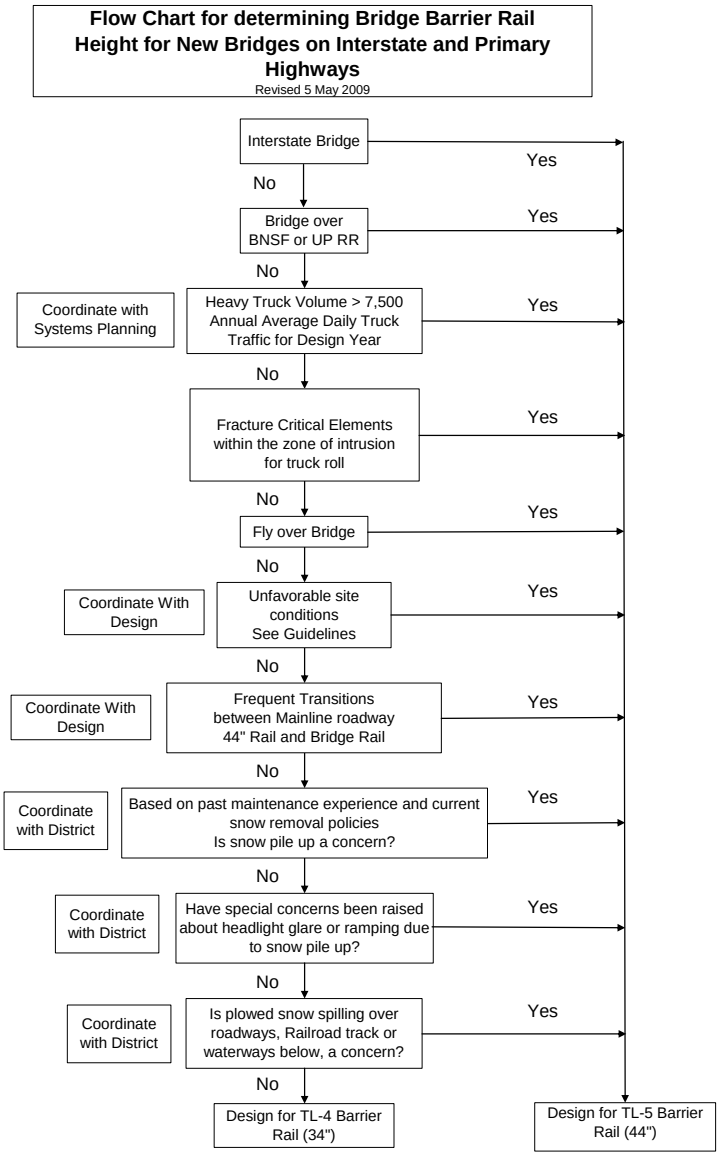

Figure 5.8.1.2.1. Flow chart for determining bridge barrier rail height on interstate and primary highways

This policy is applicable to new bridges and bridge replacements as well as to widening and repair projects that affect the existing railing. Questions regarding the policy should be directed to the Chief Structural Engineer.

5.8.1.2.1.1 F-shape [AASHTO-LRFD 13.7.3.2]

For typical bridges that carry only vehicular traffic, the office provides F-shape TL-4 or TL-5 barrier rails along the edges of the roadway. The office standard rail heights of 34 and 44 inches (865 and 1120 mm) provide TL-4 and TL-5 crash ratings, respectively [AASHTO-LRFD 13.7.3.2] and allow for a future 2 inch (50 mm) bridge deck overlay. Standard sheets give details for the typical F-shape barrier rails as summarized in Table 5.8.1.2.1.1. In most cases the complete rail design for a set of bridge plans requires both an end section sheet and a standard section sheet.

Table 5.8.1.2.1.1 Standard F-shape barrier rails for PPCB and CWPG bridges (1)

Test Level	Abutment Type	Skew	Additional Information	End or Standard Rail Section	Standard Sheet Number
TL-4	---	---	7'-0 (2.000 m) wing	End	1017
TL-4	Integral	---	---	Standard	1020A
TL-4	Integral	---	Wing extension	Standard	1020C
TL-4	Integral	---	Urban approach slab with curb	End, standard	1019A (2)
TL-4	Stub	No skew	Wing extension	Standard	1020B
TL-4	Stub	Skew	Wing extension	Standard	1018, 1018A
TL-4	Stub	No skew	Urban approach slab with curb	End, standard	1019B (2)
TL-5 (3)	Integral	---	---	Standard	1020D
TL-5 (3)	Integral	---	Wing extension	Standard	1020F
TL-5 (3)	Stub	No skew	Wing extension	Standard	1020E
TL-5 (3)	Stub	Skew	Wing extension	Standard	1018C, 1018D

Table notes:

(1) Signed standard bridge plans for CCS and RSB bridges also include details for standard F-shape barrier rails.

(2) This standard sheet currently is under review.

(3) See Figure 5.8.1.2.1.1 for a TL-5 F-shape cross section, which matches the F-shape median barrier used by the Office of Design [OD SS RE-44A].

The TL-4 and TL-5 F-shape barrier rails on the standard sheets are adequate for most National Highway System (NHS) and non-NHS highways in Iowa but, in rare cases where a TL-6 rating is required, the designer will need to specially design the rail.

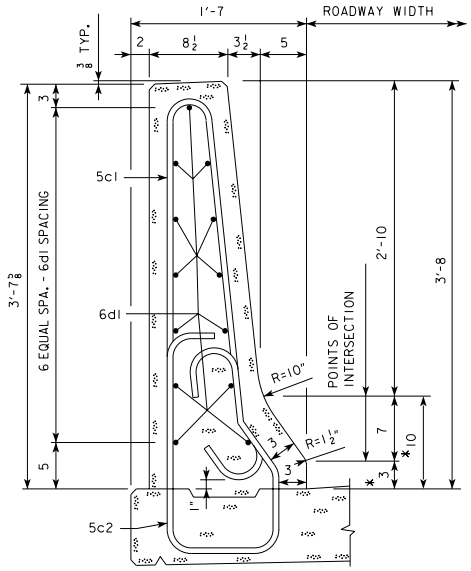

Figure notes:

- At least one 2-inch (51-mm) conduit is placed in one of the two bridge rails [OBS MM No. 163]. The second conduit is added if needed.
- No more than two conduits may be placed in one rail, and the maximum conduit sizes are two 2-inch (51-mm) or one 2-inch (51-mm) and one 3-inch (76-mm) [OBS MM No. 207].

Figure 5.8.1.2.1.1. Tall F-shape barrier rail rated TL-5

In most cases TL-4 barrier rails will provide adequate snow plowing splash protection for roadways below the bridge. If BNSF or Union Pacific Railroad tracks are below the bridge, however, office policy is to provide the TL-5 barrier rail as splashboard protection.

In cases where the bridge is near an intersection, sight distance may not be adequate, especially if the barrier rail is taller than the TL-4 rail [OBS MM No. 25]. The designer should consult with the Office of Design if barrier rails may restrict sight distance near intersections.

In some situations it may seem desirable to mount a sign support, light pole, or other structure on top of a barrier rail. However, because a vehicle may intrude above and beyond the front face of an F-shape barrier, it is preferable to place structures behind the rail. *Guidelines for Attachments to Bridge Rails and Median Barriers, Final Report* [BDM 5.8.1.1.5] gives recommendations for intrusion zones based on speed and traffic volume. If it is unreasonable to place structures outside the intrusion zone because of space or cost limitations the designer shall consult with the Office of Design.

In cases where the railing has a maximum expansion joint opening 4 inches (102 mm) or greater the designer will need to provide steel cover plates [BDM 5.8.1.2.6, OBS MM No. 207].

5.8.1.2.1.2 Open

If safety considerations require use of a TL-4 open railing the office recommends use of the railing detailed in Figure 5.8.1.2.1.2.

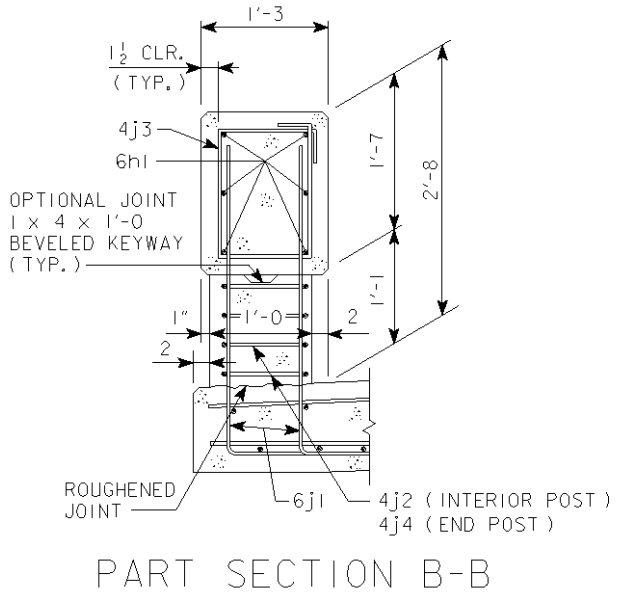

Figure note:

- No more than two conduits may be placed in one rail, and the maximum conduit sizes are two 2-inch (51-mm) or one 2-inch (51-mm) and one 3-inch (76-mm) [OBS MM No. 207].

Figure 5.8.1.2.1.2. Open railing rated TL-4

An open railing should be used only with permission of the supervising Section Leader.

5.8.1.2.1.3 Retrofit

The office has had the policy of upgrading existing traffic railings or barrier rails to TL-4 as a part of repair, overlay, or paving projects. However, under new policy [BDM 5.8.1.2.1] for deck replacement and widening projects, TL-5 rails may be required for some conditions. The requirements for retrofit barrier rails are covered in the bridge repair article of this manual [BDM 9.1.9.2.2].

5.8.1.2.2 Pedestrian railings [AASHTO-LRFD 13.8]

The office policy below for pedestrian railings currently is under discussion. As needed, contact the Methods Engineer for the policy to be applied to a specific project.

Where a sidewalk is provided on a bridge, the outer edge of the sidewalk shall be protected with a pedestrian railing. The minimum height of the railing shall be 42 inches (1.070 m) above the sidewalk surface [AASHTO-LRFD 13.8.1]. Horizontal or vertical parts of the railing shall be spaced closely enough so that a 6-inch (150 mm) sphere will not pass through the lower 27-inch (685-mm) portion and an 8-inch (200-mm) sphere will not pass through the horizontal band 27 to 42 inches (685 to 1070 mm) above the sidewalk.

The pass-through requirements above do not apply to chain link or metal fabric fence supports. Chain link or metal fabric fence shall have openings no larger than 2 inches (50 mm). It sometimes is appropriate to consider the use of smaller chain link mesh openings to discourage climbing of the fence or pushing of objects through the mesh. Smaller mesh openings may be especially appropriate near schools or playgrounds.

For a railroad overpass the Union Pacific Railroad typically requires an 8-foot (2.440-m) tall curved or a 10-foot (3.050-m) tall straight safety fence at the outer edge of a sidewalk.

Design loads for pedestrian railings and fences shall be as given in the AASHTO LRFD Specifications [AASHTO-LRFD 13.8.2].

5.8.1.2.3 Bicycle railings [AASHTO-LRFD 13.9]

The office policy below for bicycle railings currently is under discussion. As needed, contact the Methods Engineer for the policy to be applied to a specific project.

Where a shared use trail is provided on a bridge, the outer edge of the path shall be protected with a bicycle railing. The minimum height of the railing shall be 54 inches (1.372 m) above the path surface [AASHTO-LRFD 13.9.2]. Horizontal or vertical parts of the railing shall be spaced closely enough so that a 6-inch (150 mm) sphere will not pass through the lower 27-inch (685-mm) portion, and an 8-inch (200-mm) sphere will not pass through the horizontal band 27 to 54 inches (685 mm to 1.372 m) above the path surface.

The pass-through requirements do not apply to chain link or metal fabric fence supports. Chain link or metal fabric fence shall have openings no larger than 2 inches (50 mm) [AASHTO-LRFD 13.9.2]. It sometimes is appropriate to consider the use of smaller chain link mesh openings to discourage climbing of the fence or pushing of objects through the mesh. Smaller mesh openings may be especially appropriate near schools or playgrounds.

For a railroad overpass the Union Pacific Railroad typically requires an 8-foot (2.440-m) tall curved or a 10-foot (3.050-m) tall straight safety fence at the outer edge of a shared use path.

Design loads for bicycle railings shall be as given in the AASHTO LRFD Specifications [AASHTO-LRFD 13.9.3].

5.8.1.2.4 Separation railings [AASHTO-LRFD C13.7.1.1, 13.10]

The office policy below for separation railings currently is under discussion. As needed, contact the Methods Engineer for the policy to be applied to a specific project.

Where a bridge provides for pedestrian and/or bicycle traffic in addition to vehicular traffic the designer shall provide appropriate separation between the different streams of traffic. Although a barrier curb may be used for traffic speeds of 45 mph (72 kph) or less [AASHTO-LRFD C13.7.1.1], the office has the policy of providing a separation railing for all but unusual circumstances.

The following are guidelines for designing and detailing combination concrete and steel railings to be used for separation in urban areas where the vehicle speed limit is less than 45 mph (72 kph). Figure 5.8.1.2.4 shows a railing that would meet the guidelines.

- The railing shall have a vertical face on both sides.
- The concrete railing shall be a minimum of 24 inches (610 mm) high on the pedestrian side.
- The concrete railing shall be minimum of 27 inches (685 mm) and a maximum of 34 inches (865 mm) high on the traffic side.
- The concrete railing shall be a minimum of 10 inches (260 mm) thick.
- Reinforcing shall be a minimum of No. 5 (15) at 12 inch (300 mm) spacing

- The steel railing's total suggested minimum height (by AASHTO) is 42 inches (1070 mm).

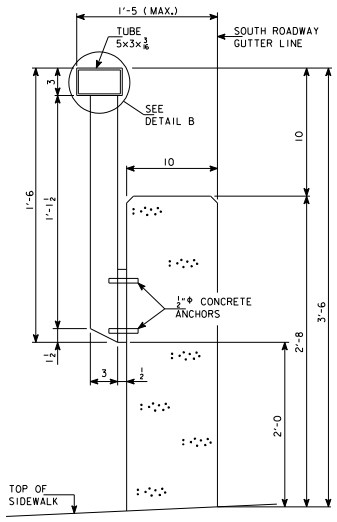

Figure 5.8.1.2.4. Separation railing (under discussion)

Alternate railings that separate pedestrian from vehicular traffic or that separate bicycle from vehicular traffic shall be designed to meet the AASHTO LRFD Specifications [AASHTO-LRFD 13.10]. The designer should note that a minimum railing height is measured from the surface that the railing protects, which is important where the roadway and sidewalk or trail surfaces are not at the same elevation.

In many cases it is undesirable to terminate a separation barrier within the limits of the bridge, as this would result in inadequate crash protection of fence, railing, or abutment features at the bridge corner outside of the sidewalk or shared use path. Sidewalk or shared use path approaches also may be adversely affected by the placement of guardrails attached to separation barriers terminating on or close to the bridge end. The designer shall consult with the Methods Section in the Office of Design regarding the appropriate terminus location and configuration for separation barriers.

5.8.1.2.5 Aesthetic and special railings [AASHTO-LRFD 13.7-13.9]

Office policy for aesthetic and special railings currently is under discussion. As needed, contact the Methods Engineer for the policy to be applied to a specific project.

Bridges that are given special aesthetic treatment usually will include redesign of standard traffic, pedestrian, bicycle, and/or combination railings. *Aesthetic Concrete Barrier Design* [BDM 5.8.1.1.5] provides guidelines for applying aesthetic treatments to various types of barriers. Also, in situations where sight distance considerations apply, railings may need to be specially designed or selected for better motorist visibility.

Design of pedestrian and bicycle railings generally can be accomplished easily within the rules for geometry and loads in the AASHTO LRFD Specifications [AASHTO-LRFD 13.8, 13.9]. Constructability and cost, however, are additional issues that the designer must consider carefully.

Aesthetic design of traffic railings is more complicated because of the need to meet a designated *NCHRP Report 350* crash test level [AASHTO-LRFD 13.7], as well as constructability and cost criteria. Furthermore, if the designer uses steel shapes such as tubes in the railing, the designer shall consult with the Chief Structural Engineer regarding special testing to ensure that the rail does not fail in a brittle mode during cold weather. For an aesthetic railing, either the designer must modify only the face of the barrier away from traffic as shown in Figure 5.8.1.2.5-1, select an already tested rail with appropriate characteristics such as the rail in Figure 5.8.1.2.5-2, or relate any new design to a crash test by crash testing the new rail directly or comparing the new rail to a similar, successfully tested rail.

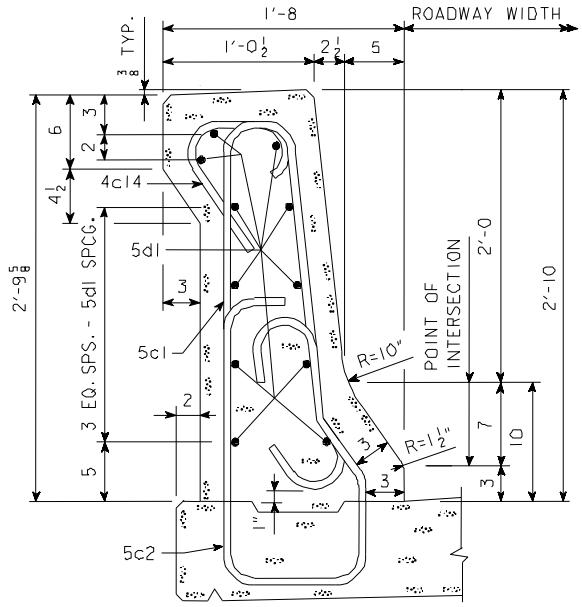

Figure notes:

- At least one 2-inch (51-mm) conduit is placed in one of the two bridge rails [OBS MM No. 163]. A second conduit is added if needed.
- No more than two conduits may be placed in one rail, and the maximum conduit sizes are two 2-inch (51-mm) or one 2-inch (51-mm) and one 3-inch (76-mm) [OBS MM No. 207].

Figure 5.8.1.2.5-1. Aesthetic F-shape barrier rail rated TL-4

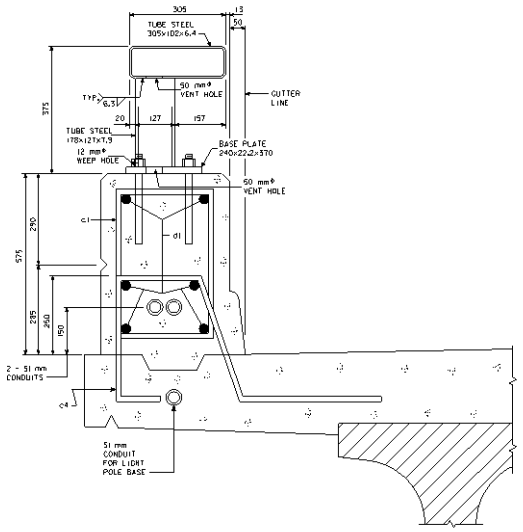

Figure notes:

- At least one 2-inch (51-mm) conduit is placed in one of the two bridge rails [OBS MM No. 163]. The second conduit is added if needed.
- No more than two conduits may be placed in one rail, and the maximum conduit sizes are two 2-inch (51-mm) or one 2-inch (51-mm) and one 3-inch (76-mm) [OBS MM No. 207].

Figure 5.8.1.2.5-2. Aesthetic partially open rail rated TL-4

The primary purpose of a traffic railing is to contain and redirect vehicles on the bridge superstructure. In order to serve that purpose a railing must be both geometrically and structurally crashworthy.

When selecting or redesigning a traffic railing, the designer should consider several principles. Safety shapes, such as the F-shape, cause the vehicle contacting the rail to climb and thereby temporarily release energy, but the climb may be sufficient to cause rollover. Vertical rails generally do not cause vehicles to tip away from the rail, which provides safety against rollover.

Because of the difference in performance with respect to climbing, the heights of the two shapes are considered differently. Heights of safety shapes generally are not restricted, but heights of vertical rails above 32 inches (813 mm) are discouraged, unless the portion above 32 inches (813 mm) is set back at least 5.5 inches (140 mm). The climbing associated with a safety shape provides safety by tipping the vehicle, thereby preventing a car occupant's head from contacting the barrier.

If any part of a rail contacted by a vehicle is not smooth, it may cause a vehicle to snag, which is undesirable. Therefore it is necessary to limit rustication depth in barrier faces to 1 inch (25 mm) or less and chamfer the edges of rustication. See "Acceptance Letter B110: Texture Guidelines for SS and Vertical Concrete Barriers" and *NCHRP Report 554* [BDM 5.8.1.1.5] for further details on acceptable traffic face rustication. Also, posts supporting a horizontal rail must be set back sufficiently so that a vehicle does not snag on a post.

Attachments to the tops of concrete barrier rails need to be considered carefully so that a vehicle that climbs the rail does not snag on the attachments or become speared by part of the attachment, or that snowplowing does not damage the attachments. Generally it is better to mount attachments that extend

above barrier rails, such as rails for bicyclists, on the backside of the rail. Additionally it may enhance safety to provide a cable tie through a pedestrian or bike rail.

Consideration also should be given toward making all or portions of barrier attachments breakaway for vehicular contact. Conditions at the backside of the barrier, such as sidewalk or edge of structure above roadway, may dictate to what extent breakaway features are employed. Consult *Guidelines for Attachments to Bridge Rails and Median Barriers, Final Report* [BDM 5.8.1.1.5] for further information.

Except for low-speed highways, the bridge railing is only part of the total safety railing. If guardrail must be attached to the bridge rail, the designer will need to plan for the attachment, usually for a thrie beam.

For most bridges, traffic railings will need to meet *NCHRP Report 350* TL-4 or TL-5. The designer may determine the test level for a proposed railing by one of three methods:

(1) Select a railing that has been tested or rated,
(2) Design and crash-test a new railing, or
(3) Compare a new railing with an existing, rated railing.

The designer shall consult the Office of Design for the proper approval procedure prior to beginning development of any new barrier configurations.

In most situations the first method will be the most economical and efficient. The Federal Highway Administration maintains a web site for NCHRP Report 350 hardware. Crash-tested or otherwise rated traffic railings are listed and described in detail. If one of the rated railings is appropriate, the designer may use the railing. The designer also may obtain additional railing information from the Methods Section in the Office of Design or from other states.

The second method, designing and crash testing a new railing, is both expensive and time consuming. In most cases this option will not be feasible due to the time delay and cost of the test.

The third method is relatively new and permitted by an FHWA memorandum dated 16 May 2000 [BDM 5.8.1.1.5]. In this method the designer needs to have detailed information on a tested railing that is very similar to the new railing. Detailed analysis of the geometry and crashworthiness and structural computations then can show that the new railing is at least equivalent to the tested railing.

In cases where the railing has a maximum expansion joint opening 4 inches (102 mm) or greater the designer will need to provide steel cover plates [BDM 5.8.1.2.6, OBS MM No. 207].

5.8.1.2.6 Concrete railings

Concrete railings shall be placed either by the slipform method with Class BR concrete [IDOT SS 2513.03, A, 2] or by the cast in place method with Class C concrete. Due to quality issues, Class D concrete no longer is permitted for placing rails by either method. The designer shall include general note E188/M188 [BDM 11.3.2] on the plans. Bid item reference information EST139/MST139 has been updated for the changes in permissible concrete class [OBS MM No. 150].

Relatively wide expansion joints in concrete barrier railings (but not open railings) require steel cover plates. The designer shall provide cover plates whenever the maximum expansion joint opening is 4 inches (102 mm) or greater. Details shall be as follows [OBS MM No. 207]:

- The entire barrier rail joint opening (front and back) shall be covered by a galvanized steel plate with a minimum thickness of 3/8 inch (10 mm) and shall extend a minimum of 9 inches (229 mm) past the expansion opening. Larger plate thicknesses should be considered for openings greater than 6 inches (152 mm).
- The plate shall be fabricated to conform to the front face of the barrier including the top. In addition, a separate back plate shall be used that meets the front plate at the top of the barrier rail.
- The joint where the two plates meet shall be sealed with light gray non-sag latex caulking sealer marketed for outdoor use.

- The exterior face of the plates shall be recessed ¼ inch (6 mm) below the surface of the rail to reduce potential for snagging.
- The cover plate will allow for the full thermal movements required at that joint location plus any setting factors that are required for the joint.

For cover plates on pedestrian, bicycle, separation, and aesthetic railings the designer shall consult with the supervising Section Leader and Aesthetic Specialist.

5.8.1.3 Temporary barrier railings

For staged construction the office usually is responsible for layout of temporary barrier rail (TBR) on the bridge deck. The TBR may be either concrete or steel; the office has discontinued use of a combination of both types of rail in the same installation. Additional information on the use of TBR is given in a bridge repair article of this manual [BDM 9.1.8.3].

5.8.1.3.1 Concrete

Concrete temporary barrier rail is detailed on several Office of Design standard road plan sheets [OD SRP RE-71(1)-(4)]. The standard rail has a double F-shape, a 32-inch (813-mm) height, and 12.5-foot (3.810-m) lengths.

Typical layout of the rail for one-way and two-way traffic is shown on standard sheets [OBS SS 1049, 1050]. Details of the placement policy are given elsewhere in this manual [BDM 9.1.8.3].

Rules for use of tie-downs are given in the Office of Design's design manual [OD DM 9B-9] and on a standard sheet [RE-71(3)].

5.8.1.3.2 Steel

Steel HP 14x73 (HP 360x108) temporary barrier rail is composed of two pile sections welded flange tip to flange tip, with a concrete fill. The height of the cross section is 29.25 inches (743 mm), and the length of a rail section is 20 feet (6.096 m).

Typical layout of the rail for one-way and two-way traffic is shown on standard sheets [OBS SS 1056, 1058]. Details of the placement policy are given elsewhere in this manual [BDM 9.1.8.3].